

WE CLAIM:

1. Apparatus for the servicing of a bore hole in the earth, comprising:
a first sub-assembly adapted for the insertion and removal of a continuous length of coiled tubing into and from said bore hole; and
a second sub-assembly adapted for the vaporization of liquified gas and the pumping of the resulting gas through said coiled tubing into said bore hole; and
platform means adapted to support said first and second sub-assemblies thereon.
2. The apparatus of claim 1 wherein said second sub-assembly includes first heat exchanger means for vaporization of said liquified gas, said heat exchanger means allowing heat transfer between a heat transferring fluid and said liquified gas.
3. The apparatus of claim 2 wherein said heat transferring fluid is heated in part by waste heat from an internal combustion engine.
4. The apparatus of claim 3 wherein said second sub-assembly additionally includes means for loading said internal combustion engine.
5. The apparatus of claim 4 wherein said means for loading comprise a water brake drivingly connected to said internal combustion engine.
6. The apparatus of claim 5 wherein at least a portion of said heat transferring fluid is circulated through said water brake for the transfer of heat to said fluid, said water brake having a first inlet for said heat transferring fluid and an outlet for the discharge thereof.
7. The apparatus of claim 6 additionally comprising a first reservoir having an inlet for receiving said heat transferring fluid from said outlet of said water brake and an outlet for the discharge of said heat transferring fluid to said first heat exchanger.

8. The apparatus of claim 7 including a first pump for circulating said heat exchanging fluid through said water brake and said first heat exchanger.
9. The apparatus of claim 8 wherein said first pump has an intake in fluid communication with said outlet of said first reservoir and a discharge in fluid communication with said inlet to said first heat exchanger and said first inlet to said water brake.
10. The apparatus of claim 9 additionally comprising a second heat exchanger having first and second inlets and first and second outlets, said first inlet being in fluid communication with said internal combustion engine to receive heated coolant therefrom, said first outlet being in fluid communication with said internal combustion engine for the return of said coolant thereto, said second outlet being in fluid communication with said inlet to said first pump and said second inlet being in fluid communication with an outlet of said first heat exchanger for receiving said heat transferring fluid therefrom.
11. The apparatus of claim 9 wherein said water brake includes one or more secondary inlets in fluid communication with said discharge of said first pump, and sized for the delivery of a reduced amount of heat transferring fluid into said water brake.
12. The apparatus of claim 10 including valve means disposed between said first pump and said first inlet of said water brake, said valve being operable to control the flow of said heat transferring fluid through said first inlet of said water brake.
13. The apparatus of claim 11 wherein, when said valve means are closed, heat transferring fluid continues to be discharged in a reduced amount into said water brake through said secondary inlets for cooling and lubrication.
14. The apparatus of claim 12 wherein said heat transferring fluid flowing through said secondary inlets is directed at seals and/or bearings in said water brake.

15. The apparatus of claim 13 including an air line for delivering pressurized air into said first inlet of said water brake when said valve means are closed, wherein said pressurized air forces said heat transferring fluid from said water brake to substantially empty the same.
16. The apparatus of claim 14 wherein said substantially empty water brake imposes reduced or no loading on said internal combustion engine without being drivingly disconnected therefrom.
17. The apparatus of claim 16 including a vessel for said pressurized air, said vessel being located above said first reservoir and having an inlet in fluid communication therewith and an outlet for delivery of said pressurized air through said air line to said water brake.
18. The apparatus of claim 17 wherein said air line includes a one-way check valve therein permitting the flow of pressurized air into said water brake but preventing the flow of heat transferring fluid into said vessel.
19. The apparatus of any of claim 10 including a second pump for pumping said liquified gas through said first heat exchanger and into said bore hole.
20. The apparatus of claim 19 including a tank for said liquified gas.
21. The apparatus of claim 20 including a third pump disposed in fluid communication between said tank and said second pump for boosting the pressure of said liquified gas into said second pump.
22. The apparatus of claim 21 wherein said first, second and third pumps are hydraulically actuated.
23. The apparatus of claim 22 including a hydraulic pump for actuation of said first, second and third pumps.

24. The apparatus of claim 23 wherein said hydraulic pump is drivingly connected to said internal combustion engine.
25. The apparatus of claim 24 including a gearbox drivingly connected to said internal combustion engine, said gearbox having two outlets, said water brake being drivingly connected to one of said outlets and said hydraulic motor being drivingly connected to the other of said outlets.
26. The apparatus of claim 25 including a third heat exchanger for transferring heat from hydraulic fluid circulating through said first, second and third pumps to said heat transferring fluid.
27. The apparatus of claim 1 wherein said liquified gas is liquified nitrogen.
28. A hybrid coiled tubing and pumping rig for servicing a well comprising:
a coiled tubing spool;
coiled tubing wound about said spool;
a coiled tubing injector for injecting said coiled tubing into said well;
a guide arch for guiding said coiled tubing into said injector;
a flameless heating unit for heating a liquified gas to produce gas; and
a first pump for pumping said gas through said coiled tubing into said well wherein said spool, injector, flameless heating unit and first pump are supported on a single platform for transportation and use.
29. The hybrid rig of claim 28 wherein said first pump additionally pumps said liquified gas through said flameless heating unit.
30. The hybrid rig of claim 29 wherein said flameless heating unit comprises:
a heat exchanger for vaporizing said liquified gas by heat transfer between a heat exchanging fluid and said liquified gas;
a source of heat for said heat exchanging fluid;

a second pump for pumping said heat exchanging fluid through said heat exchanger and said source of heat; and

a reservoir for said heat exchanging fluid wherein said heat exchanging fluid is circulated from said reservoir, through said second pump, said heat exchanger, said source of heat and back to said reservoir.

31. The hybrid rig of claim 30 wherein said source of heat includes a water brake drivingly connected to a prime mover.

32. The hybrid rig of claim 31 wherein said source of heat includes a second heat exchanger for extracting heat from said prime mover's coolant.

33. The hybrid rig of claim 32 wherein said second pump circulates at least a portion of said heat exchanging fluid through said water brake and another portion of said fluid through said second heat exchanger.

34. The hybrid rig of claim 33 wherein said flameless heating unit additionally comprises:
a supply line providing fluid communication between said second pump and a first inlet into said water brake;

a valve in said supply line, said valve allowing said heat exchanging fluid to flow into said first inlet of said water brake when open and stopping said flow when closed;

an airline connected to said supply line between said water brake and said valve for the flow of pressurized air into said first inlet;

a one way check valve in said airline to prevent the reverse flow of said heat exchanging fluid therethrough;

a return line providing fluid communication between an outlet from said water brake and said reservoir; and

an expansion tank for said pressurized air connected above said reservoir in fluid communication therewith, whereby opening said valve allows said heat exchanging fluid to flow through said water brake and closing said valve allows said pressurized air to flow into said water brake for purging said heat exchanging fluid therefrom.

35. The hybrid rig of claim 34 wherein said source of heat includes a third heat exchanger for extracting heat from hydraulic fluid used for actuating said first and second pumps.
36. The hybrid rig of claim 34 wherein said water brake additionally comprises:
a hardened housing;
bearings fluid seals; and
one or more additional inlets for said heat exchanging fluid to cool said bearings and seals, whereby said hardened housing and said fluid cooled bearings and seals allow said water brake to run when said valve is closed for unloading said prime mover without disconnecting said water brake therefrom.
37. The hybrid rig of claim 33 wherein said coiled tubing is directly coupled to said flameless heating unit.
38. The hybrid rig of claim 33 wherein said liquified gas is liquid nitrogen.
39. The hybrid rig of claim 38 wherein said heat exchanging fluid is water, glycol or a mixture thereof.
40. The hybrid rig of claim 39 additionally comprising a hydraulically actuated boom.
41. The hybrid rig of claim 40 wherein said prime mover provides power for actuation of said spool, tubing injector and boom.
42. A method for the servicing of a bore hole in the earth by injecting a pressurized gas thereinto, comprising the steps of supporting a first sub-assembly adapted for the insertion and removal of a continuous length of coiled tubing into and from said bore hole on a platform; and supporting a second sub-assembly adapted for the vaporization of liquified gas and the pumping of the resulting gas through said coiled tubing to said bore on said same platform.